



COLORADO
**Division of Reclamation,
Mining and Safety**
Department of Natural Resources
1313 Sherman Street, Room 215
Denver, CO 80203

MEMORANDUM

Date: April 13, 2021

To: Brock Bowles; Division of Reclamation, Mining & Safety

From: Peter Hays; Division of Reclamation, Mining & Safety

Re: **Second Adequacy Review of Exhibit 6.5 - Geotechnical Stability
Prowers Aggregate Operators, LLC; West Farm Pit; File No. M-2008-078;
Amendment No. 2 (AM-02)**

The Division of Reclamation, Mining and Safety (Division/DRMS) reviewed the Slope Stability Report adequacy response submitted by J&T Consulting, Inc. (J&T) dated April 2, 2021 for the West Farm Pit 112c permit amendment (AM-02) application.

In accordance with Table 1 - Recommended Factors of Safety for Slope Stability Analysis for Operations and Reclamation within Section 30.4 of the Policies of the Mined Land Reclamation Board (MLRB) effective May 16, 2018, the Division will require the Applicant to comply with the factor of safety (FOS) of 1.5 for critical structures and 1.3 for non-critical structures in static conditions and 1.3 for critical structures and 1.15 for non-critical structures in seismic conditions since the Applicant utilized generalized strength measurements in the analysis.

Based on the information provided by the Operator, the Division accepts the J&T slope stability report as an alternative to the Operator obtaining agreements with all structure owners within 200-feet of the affected lands, if structure agreement cannot be obtain by the Operator.

If groundwater is intercepted and/or the soils differ from the expected and modeled profiles, the Operator must contact the Division immediately and reevaluate the slope stability analysis based on the updated information. Please note any transgression from the proposed slope geometries and/or proposed offsets will be considered a violation, if the amendment application is approved and issued by the Division. The Division's stability analysis model results are attached.

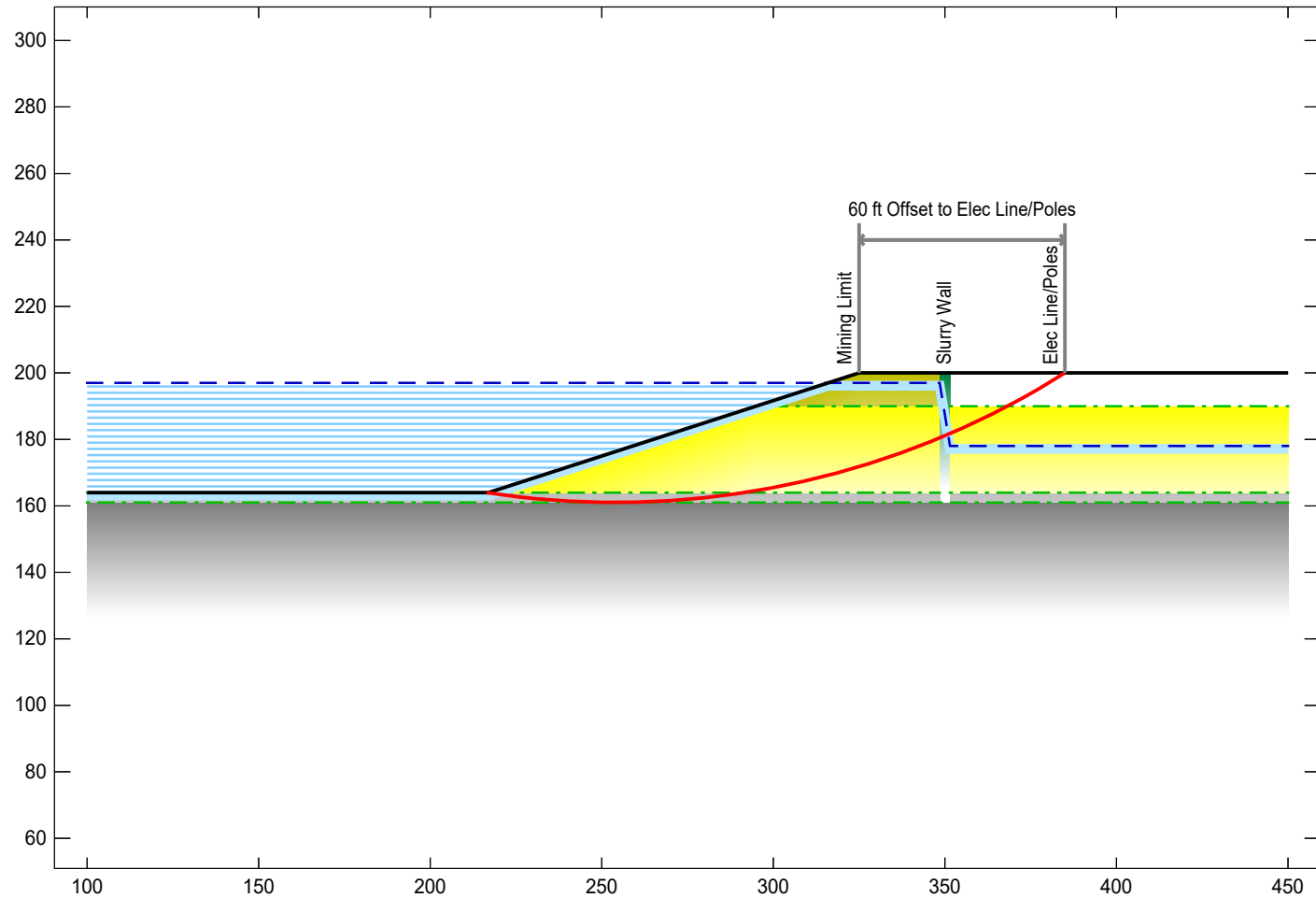
The Division duplicated the Operator's slope stability analysis for Case 5-3 using Clover Technologies Galena Slope Stability Analysis System, Version 7.2 with the X-Right coordinate maintained at the edge of easement and/or structure. Tables of the Applicant's and the Division's analysis factor of safety (FOS) results for static and seismic conditions are below:



Analysis Name – Static Condition	Applicant's FOS	DRMS FOS	Required FOS
Case 5-3 – Electric Line/Poles to the West of Phase 5 – Full Reservoir	2.96	2.96	1.5
Case 5-3 – Electric Line/Poles to the West of Phase 5 – Rapid Drawdown	1.64	1.64	1.5

Analysis Name – Seismic Condition	Applicant's FOS	DRMS FOS	Required FOS
Case 5-3 – Electric Line/Poles to the West of Phase 5 – Full Reservoir	2.20	2.20	1.3
Case 5-3 – Electric Line/Poles to the West of Phase 5 – Rapid Drawdown	1.36	1.36	1.3

If you have any questions regarding these adequacy items, please contact me at peter.hays@state.co.us or (303) 866-3567, Ext. 8124.



GALENA Version 7.2

Material Keys

- 1: Overburden
- 2: Sand and Gravel
- 3: Weathered Bedrock
- 4: Stable Bedrock
- 5: Slurry Wall

Analysis 1

Single Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

Factor of Safety: 2.96

Edited: 13 Apr 2021 Processed: 13 Apr 2021

Project West Farm Pit Expansion
Case 5-3 Full Reservoir

File: G:\My Driv...\DRMS West Farm Expansion Case 5-3 Full Reservoir.gmf

Dept of the Interior - Office of Surface Mining

Project: West Farm Pit Expansion
 File: G:\My Drive\1 - My Projects Google\8 Galena - Stability Analysis...\DRMS West Farm Expansion Case 5-3 Full Reservoir.gmf
 Processed: 13 Apr 2021 09:01:46

DATA: Analysis 1 - Case 5-3 Full Reservoir

Material Properties (5 materials)

```

Material: 1 (Mohr-Coulomb Isotropic) - Overburden
Cohesion  Phi  UnitWeight  Ru
150.00    22.0    131.00    Auto
Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel
Cohesion  Phi  UnitWeight  Ru
0.00     35.0    131.00    Auto
Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock
Cohesion  Phi  UnitWeight  Ru
100.00    18.0    141.00    Auto
Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock
Cohesion  Phi  UnitWeight  Ru
2000.00   20.0    141.00    Auto
Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall
Cohesion  Phi  UnitWeight  Ru
0.00     45.0    110.00    Auto
  
```

Water Properties

```

Unit weight of water: 62.400          Unit weight of water/medium above ground: 62.400
  
```

Material Profiles (9 profiles)

```

Profile: 1 (2 points)  Material beneath: 1 - Overburden
100.00    200.00    348.50    200.00
Profile: 2 (2 points)  Material beneath: 2 - Sand and Gravel
100.00    190.00    348.50    190.00
Profile: 3 (2 points)  Material beneath: 3 - Weathered Bedrock
100.00    164.00    348.50    164.00
Profile: 4 (2 points)  Material beneath: 4 - Stable Bedrock
100.00    161.00    348.50    161.00
Profile: 5 (2 points)  Material beneath: 5 - Slurry Wall
348.50    200.00    351.50    200.00
Profile: 6 (2 points)  Material beneath: 1 - Overburden
351.50    200.00    450.00    200.00
Profile: 7 (2 points)  Material beneath: 2 - Sand and Gravel
351.50    190.00    450.00    190.00
Profile: 8 (2 points)  Material beneath: 3 - Weathered Bedrock
351.50    164.00    450.00    164.00
Profile: 9 (2 points)  Material beneath: 4 - Stable Bedrock
348.50    161.00    450.00    161.00
  
```

Slope Surface (4 points)

```

-----
100.00    164.00    217.00    164.00    325.00    200.00    450.00    200.00
  
```

Phreatic Surface (4 points)

```

-----
100.00    197.00    348.50    197.00    351.50    178.00    450.00    178.00
  
```

Failure Surface

Circular surface defined by: XL, XR, R

Intersects: XL: 216.47 YL: 164.00 XR: 385.00 YR: 200.00
Centre: XC: 253.99 YC: 400.85 Radius: R: 239.80

RESULTS: Analysis 1 - Case 5-3 Full Reservoir

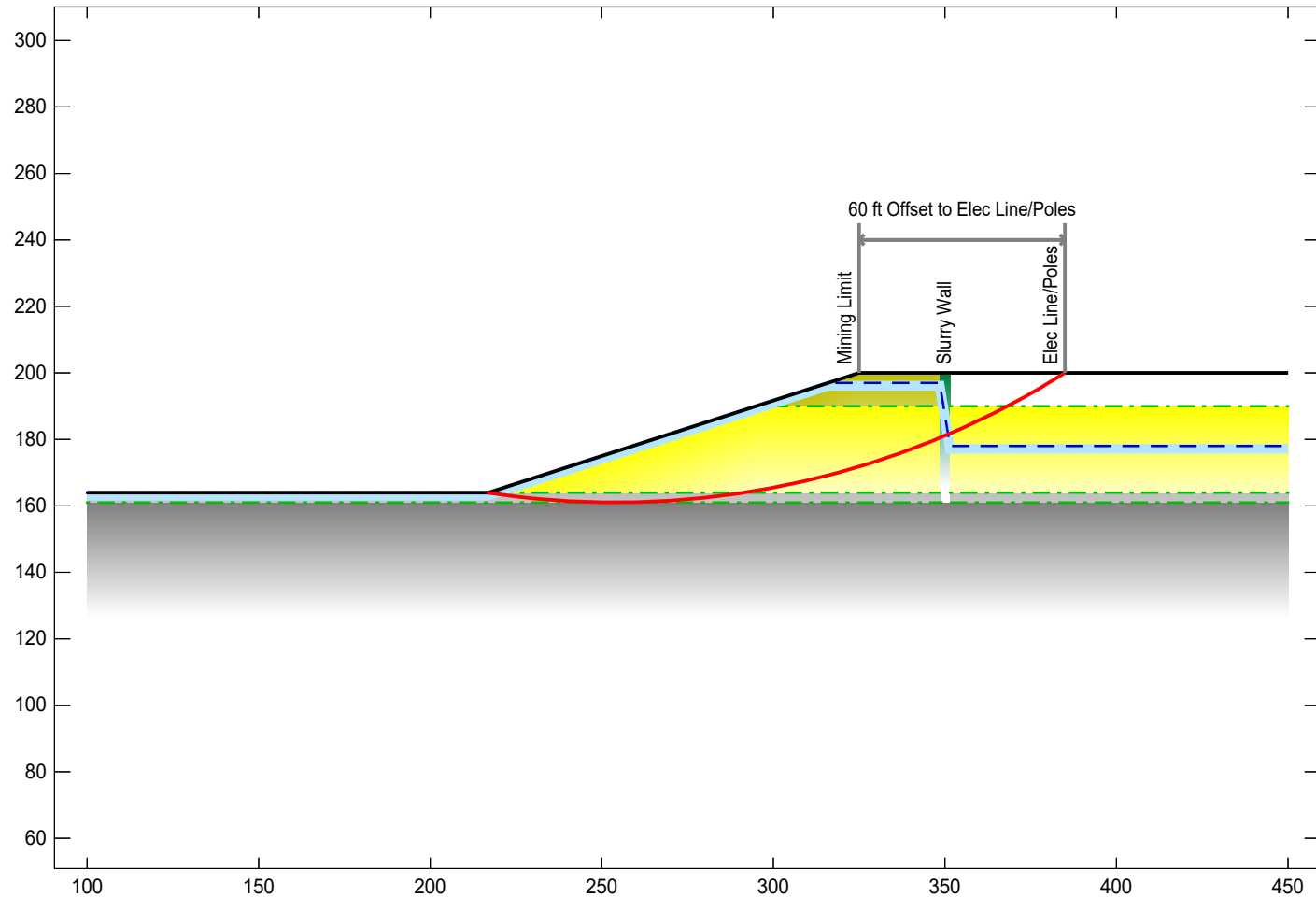
Bishop Simplified Method of Analysis - Circular Failure Surface

Factor of Safety: 2.96

Slice Geometry and Properties (43 slices)

Slice	X-S			Base					PoreWater			Normal	Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor	
1	216.47	4.17	-7.9	4.59	4.64	3	100.00	18.0	560.88	9643.80	2150.28	1.03	
2	221.06	14.13	-7.9	4.59	4.64	3	100.00	18.0	1895.30	9828.12	2347.55	1.03	
3	225.66	23.81	-5.7	4.62	4.64	3	100.00	18.0	3188.82	9986.78	2529.40	1.02	
4	230.27	33.03	-5.7	4.62	4.64	3	100.00	18.0	4417.73	10119.56	2701.19	1.02	
5	234.89	41.98	-3.5	4.63	4.64	3	100.00	18.0	5607.08	10226.31	2856.32	1.01	
6	239.52	50.42	-3.5	4.63	4.64	3	100.00	18.0	6725.90	10307.35	3002.50	1.01	
7	244.15	58.55	-1.2	4.64	4.64	3	100.00	18.0	7799.39	10362.53	3130.93	1.00	
8	248.79	66.18	-1.2	4.64	4.64	3	100.00	18.0	8804.25	10391.63	3251.42	1.00	
9	253.43	73.41	1.0	4.64	4.64	3	100.00	18.0	9751.17	10394.59	3353.21	1.00	
10	258.06	80.21	1.0	4.64	4.64	3	100.00	18.0	10638.90	10371.83	3447.95	1.00	
11	262.70	86.47	3.2	4.63	4.64	3	100.00	18.0	11451.28	10323.16	3523.18	1.00	
12	267.33	92.43	3.2	4.63	4.64	3	100.00	18.0	12219.30	10248.43	3592.16	1.00	
13	271.96	97.67	5.4	4.62	4.64	3	100.00	18.0	12889.86	10147.71	3640.93	0.99	
14	276.58	102.76	5.4	4.62	4.64	3	100.00	18.0	13536.31	10021.12	3684.15	0.99	
15	281.20	106.95	7.6	4.60	4.64	3	100.00	18.0	14060.69	9868.94	3706.61	0.99	
16	285.80	111.17	7.6	4.60	4.64	3	100.00	18.0	14584.72	9690.80	3724.14	0.99	
17	290.39	24.64	9.8	1.00	1.01	3	100.00	18.0	3228.48	2088.71	3723.62	1.00	
18	291.39	90.52	9.8	3.61	3.66	2	0.00	35.0	11858.17	7469.98	3692.70	0.97	
19	295.00	116.72	9.8	4.54	4.60	2	0.00	35.0	15290.32	9185.56	3691.52	0.97	
20	299.54	119.62	12.1	4.54	4.64	2	0.00	35.0	15670.50	9002.54	3662.81	0.97	
21	304.07	122.09	12.1	4.54	4.64	2	0.00	35.0	15993.22	8722.07	3637.81	0.97	
22	308.61	101.02	14.3	3.70	3.81	2	0.00	35.0	13233.75	6944.36	3589.24	0.97	
23	312.30	102.10	14.3	3.70	3.81	2	0.00	35.0	13375.07	6720.61	3549.43	0.97	
24	316.00	44.48	14.3	1.60	1.65	2	0.00	35.0	5826.62	2836.44	3536.59	0.97	
25	317.60	103.49	16.5	3.70	3.86	2	0.00	35.0	13557.49	6458.11	3532.97	0.97	
26	321.30	104.00	16.5	3.70	3.86	2	0.00	35.0	13624.28	6194.17	3545.39	0.97	
27	325.00	41.74	16.5	1.49	1.56	2	0.00	35.0	5468.51	2425.01	3523.63	0.97	
28	326.49	118.55	18.7	4.39	4.64	2	0.00	35.0	15530.59	6942.11	3383.78	0.98	
29	330.89	112.02	18.7	4.39	4.64	2	0.00	35.0	14674.43	6511.54	3196.46	0.98	
30	335.28	103.66	20.9	4.33	4.64	2	0.00	35.0	13579.04	6056.54	2982.44	0.98	
31	339.61	96.48	20.9	4.33	4.64	2	0.00	35.0	12638.69	5577.00	2774.85	0.98	
32	343.95	93.21	23.1	4.55	4.95	2	0.00	35.0	12210.69	5398.17	2534.98	0.99	
33	348.50	46.28	23.1	2.44	2.65	5	0.00	45.0	5091.17	1365.22	1888.50	0.95	
34	350.94	27.85	23.1	1.54	1.67	2	0.00	35.0	3647.80	0.00	2156.00	0.99	
35	352.48	70.42	25.4	4.19	4.64	2	0.00	35.0	9225.22	0.00	1978.97	1.00	
36	356.67	62.09	25.4	4.19	4.64	2	0.00	35.0	8134.39	0.00	1744.97	1.00	
37	360.86	47.06	27.6	3.66	4.13	2	0.00	35.0	6165.21	0.00	1500.04	1.00	
38	364.52	40.07	27.6	3.66	4.13	2	0.00	35.0	5249.78	0.00	1277.31	1.00	
39	368.18	8.86	27.6	0.91	1.02	1	150.00	22.0	1160.09	0.00	1169.16	1.05	
40	369.08	33.71	29.8	4.03	4.64	1	150.00	22.0	4415.97	0.00	990.56	1.07	

41	373.11	24.43	29.8	4.03	4.64	1	150.00	22.0	3200.63	0.00	710.54	1.07
42	377.13	14.50	32.0	3.93	4.64	1	150.00	22.0	1900.14	0.00	415.93	1.09
43	381.07	4.83	32.0	3.93	4.64	1	150.00	22.0	633.38	0.00	119.18	1.09
X-S Area:		-----	Path Length:		-----	X-S Weight:		-----				
		2917.79			176.26			382715.25				



GALENA Version 7.2

Material Keys

1: Overburden

2: Sand and Gravel

3: Weathered Bedrock

4: Stable Bedrock

5: Slurry Wall

Analysis 1

Single Stability Analysis

Method: Bishop Simplified

Surface: Circular

Results

Factor of Safety: 1.64

Edited: 13 Apr 2021 Processed: 13 Apr 2021

Project West Farm Pit Expansion
Case 5-3 Rapid Drawdown

File: C:\Users\p...\DRMS West Farm Expansion Case 5-3 Rapid Drawdown.gmf

Dept of the Interior - Office of Surface Mining

Project: West Farm Pit Expansion
 File: C:\Users\psh\AppData\Local\Temp\2\Temp5_Adequacy Review 1 Respon...\DRMS West Farm Expansion Case 5-3 Rapid Drawdown.gmf
 Processed: 13 Apr 2021 09:07:30

DATA: Analysis 1 - Case 5-3 Rapid Drawdown

Material Properties (5 materials)

```

Material: 1 (Mohr-Coulomb Isotropic) - Overburden
Cohesion  Phi  UnitWeight  Ru
150.00    22.0    131.00    Auto
Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel
Cohesion  Phi  UnitWeight  Ru
0.00     35.0    131.00    Auto
Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock
Cohesion  Phi  UnitWeight  Ru
100.00    18.0    141.00    Auto
Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock
Cohesion  Phi  UnitWeight  Ru
2000.00   20.0    141.00    Auto
Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall
Cohesion  Phi  UnitWeight  Ru
0.00     45.0    110.00    Auto
  
```

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

```

Profile: 1 (2 points)   Material beneath: 1 - Overburden
100.00    200.00        348.50    200.00
Profile: 2 (2 points)   Material beneath: 2 - Sand and Gravel
100.00    190.00        348.50    190.00
Profile: 3 (2 points)   Material beneath: 3 - Weathered Bedrock
100.00    164.00        348.50    164.00
Profile: 4 (2 points)   Material beneath: 4 - Stable Bedrock
100.00    161.00        348.50    161.00
Profile: 5 (2 points)   Material beneath: 5 - Slurry Wall
348.50    200.00        351.50    200.00
Profile: 6 (2 points)   Material beneath: 1 - Overburden
351.50    200.00        450.00    200.00
Profile: 7 (2 points)   Material beneath: 2 - Sand and Gravel
351.50    190.00        450.00    190.00
Profile: 8 (2 points)   Material beneath: 3 - Weathered Bedrock
351.50    164.00        450.00    164.00
Profile: 9 (2 points)   Material beneath: 4 - Stable Bedrock
348.50    161.00        450.00    161.00
  
```

Slope Surface (4 points)

```

-----
100.00    164.00    217.00    164.00    325.00    200.00    450.00    200.00
  
```

Phreatic Surface (6 points)

```

-----
100.00    164.00    217.00    164.00    316.00    197.00    348.50    197.00    351.50    178.00
450.00    178.00
  
```

Failure Surface

Circular surface defined by: XL, XR, R

Intersects: XL: 216.47 YL: 164.00 XR: 385.00 YR: 200.00
Centre: XC: 253.99 YC: 400.85 Radius: R: 239.80

RESULTS: Analysis 1 - Case 5-3 Rapid Drawdown

Bishop Simplified Method of Analysis - Circular Failure Surface

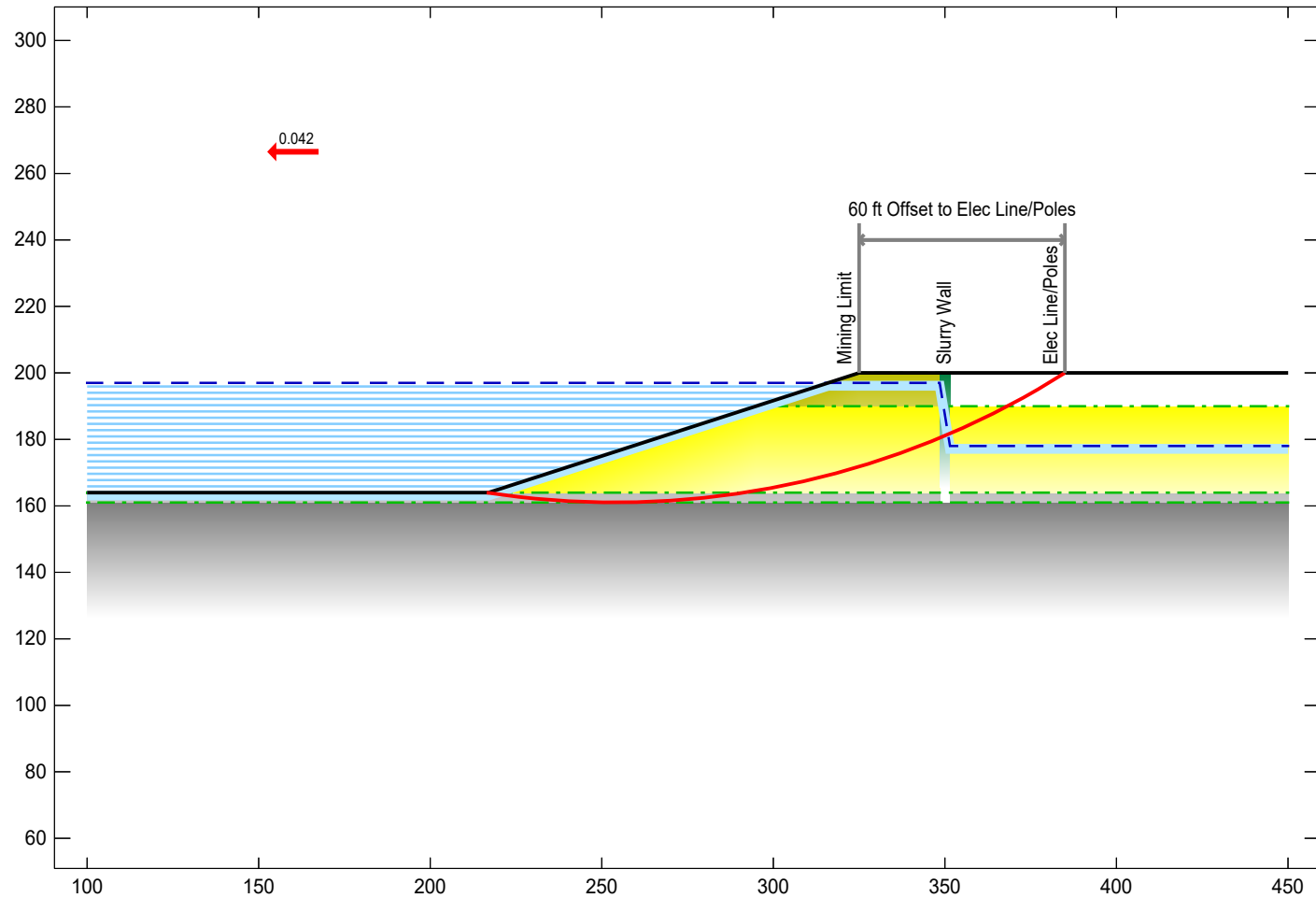
Factor of Safety: 1.64

Slice Geometry and Properties (43 slices)

Slice	X-Left	X-S Area	Angle	Width	Base Length	Matl	Cohesion	Phi	Weight	Porewater Force	Normal Stress	Test Factor
1	216.47	4.17	-7.9	4.59	4.64	3	100.00	18.0	560.88	262.69	132.61	1.04
2	221.06	14.13	-7.9	4.59	4.64	3	100.00	18.0	1895.30	890.32	427.42	1.04
3	225.66	23.81	-5.7	4.62	4.64	3	100.00	18.0	3188.82	1493.22	704.43	1.03
4	230.27	33.03	-5.7	4.62	4.64	3	100.00	18.0	4417.73	2071.34	973.52	1.03
5	234.89	41.98	-3.5	4.63	4.64	3	100.00	18.0	5607.08	2624.22	1222.57	1.01
6	239.52	50.42	-3.5	4.63	4.64	3	100.00	18.0	6725.90	3151.94	1465.76	1.01
7	244.15	58.55	-1.2	4.64	4.64	3	100.00	18.0	7799.39	3654.11	1687.01	1.00
8	248.79	66.18	-1.2	4.64	4.64	3	100.00	18.0	8804.25	4130.65	1904.18	1.00
9	253.43	73.41	1.0	4.64	4.64	3	100.00	18.0	9751.17	4581.15	2097.77	1.00
10	258.06	80.21	1.0	4.64	4.64	3	100.00	18.0	10638.90	5005.81	2288.84	1.00
11	262.70	86.47	3.2	4.63	4.64	3	100.00	18.0	11451.28	5404.24	2454.92	0.99
12	267.33	92.43	3.2	4.63	4.64	3	100.00	18.0	12219.30	5776.34	2619.82	0.99
13	271.96	97.67	5.4	4.62	4.64	3	100.00	18.0	12889.86	6121.85	2758.57	0.99
14	276.58	102.76	5.4	4.62	4.64	3	100.00	18.0	13536.31	6440.81	2897.27	0.99
15	281.20	106.95	7.6	4.60	4.64	3	100.00	18.0	14060.69	6733.14	3008.88	0.98
16	285.80	111.17	7.6	4.60	4.64	3	100.00	18.0	14584.72	6998.57	3121.39	0.98
17	290.39	115.40	9.8	4.58	4.64	3	100.00	18.0	15108.85	7263.82	3233.90	0.98
18	294.98	119.62	9.8	4.58	4.64	2	0.00	35.0	11858.17	5732.83	3167.61	0.94
19	299.57	123.84	9.8	4.54	4.60	2	0.00	35.0	15290.32	7392.10	3249.80	0.94
20	304.16	128.06	12.1	4.54	4.64	2	0.00	35.0	15670.50	7632.82	3303.43	0.94
21	308.75	132.28	12.1	4.54	4.64	2	0.00	35.0	15993.22	7790.01	3371.46	0.94
22	313.34	136.50	14.3	3.70	3.81	2	0.00	35.0	13233.75	6504.53	3396.75	0.93
23	317.93	140.72	14.3	3.70	3.81	2	0.00	35.0	13375.07	6574.00	3432.99	0.93
24	322.52	144.94	14.3	1.60	1.65	2	0.00	35.0	5826.62	2836.44	3457.33	0.93
25	327.11	149.16	16.5	3.70	3.86	2	0.00	35.0	13557.49	6458.11	3440.04	0.93
26	331.70	153.38	16.5	3.70	3.86	2	0.00	35.0	13624.28	6194.17	3448.42	0.93
27	336.29	157.60	16.5	1.49	1.56	2	0.00	35.0	5468.51	2425.01	3425.35	0.93
28	340.88	161.82	18.7	4.39	4.64	2	0.00	35.0	15530.59	6942.11	3277.63	0.92
29	345.47	166.04	18.7	4.39	4.64	2	0.00	35.0	14674.43	6511.54	3095.61	0.92
30	350.06	170.26	20.9	4.33	4.64	2	0.00	35.0	13579.04	6056.54	2877.65	0.92
31	354.65	174.48	20.9	4.33	4.64	2	0.00	35.0	12638.69	5577.00	2676.57	0.92
32	359.24	178.70	23.1	4.55	4.95	2	0.00	35.0	12210.69	5398.17	2435.67	0.92
33	363.83	182.92	23.1	2.44	2.65	5	0.00	45.0	5091.17	1365.22	1762.00	0.86
34	368.42	187.14	23.1	1.54	1.67	2	0.00	35.0	3647.80	0.00	2007.83	0.92
35	373.01	191.36	25.4	4.19	4.64	2	0.00	35.0	9225.22	0.00	1830.65	0.92
36	377.60	195.58	25.4	4.19	4.64	2	0.00	35.0	8134.39	0.00	1614.18	0.92
37	382.19	199.80	27.6	3.66	4.13	2	0.00	35.0	6165.21	0.00	1378.25	0.92
38	386.78	204.02	27.6	3.66	4.13	2	0.00	35.0	5249.78	0.00	1173.60	0.92
39	391.37	208.24	27.6	0.91	1.02	1	150.00	22.0	1160.09	0.00	1090.96	1.00

40	369.08	33.71	29.8	4.03	4.64	1	150.00	22.0	4415.97	0.00	915.60	1.01
41	373.11	24.43	29.8	4.03	4.64	1	150.00	22.0	3200.63	0.00	650.99	1.01
42	377.13	14.50	32.0	3.93	4.64	1	150.00	22.0	1900.14	0.00	369.15	1.02
43	381.07	4.83	32.0	3.93	4.64	1	150.00	22.0	633.38	0.00	90.04	1.02

X-S Area:	----- 2917.79	Path Length:	----- 176.26	X-S Weight:	----- 382715.25
-----------	------------------	--------------	-----------------	-------------	--------------------



Material Keys

1: Overburden

2: Sand and Gravel

3: Weathered Bedrock

4: Stable Bedrock

5: Slurry Wall

Analysis 1

Single Stability Analysis

Method: Bishop Simplified

Surface: Circular

Results

Factor of Safety: 2.20

Edited: 13 Apr 2021 Processed: 13 Apr 2021

Project West Farm Pit Expansion
Case 5-3 Full Reservoir - Pseudostatic

File: C:\Users\p...\DRMS West Farm Expansion Case 5-3 Full Reservoir-EQ.gmf

Dept of the Interior - Office of Surface Mining

Project: West Farm Pit Expansion
 File: C:\Users\psh\AppData\Local\Temp\2\Temp5_Adequacy Review 1 Res...\DRMS West Farm Expansion Case 5-3 Full Reservoir-EQ.gmf
 Processed: 13 Apr 2021 09:05:12

DATA: Analysis 1 - Case 5-3 Full Reservoir - Pseudostatic

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden
Cohesion Phi UnitWeight Ru
150.00 22.0 131.00 Auto
Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel
Cohesion Phi UnitWeight Ru
0.00 35.0 131.00 Auto
Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock
Cohesion Phi UnitWeight Ru
100.00 18.0 141.00 Auto
Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock
Cohesion Phi UnitWeight Ru
2000.00 20.0 141.00 Auto
Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall
Cohesion Phi UnitWeight Ru
0.00 45.0 110.00 Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden
100.00 200.00	348.50 200.00
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel
100.00 190.00	348.50 190.00
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock
100.00 164.00	348.50 164.00
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock
100.00 161.00	348.50 161.00
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall
348.50 200.00	351.50 200.00
Profile: 6 (2 points)	Material beneath: 1 - Overburden
351.50 200.00	450.00 200.00
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel
351.50 190.00	450.00 190.00
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock
351.50 164.00	450.00 164.00
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock
348.50 161.00	450.00 161.00

Slope Surface (4 points)

100.00	164.00	217.00	164.00	325.00	200.00	450.00	200.00
--------	--------	--------	--------	--------	--------	--------	--------

Phreatic Surface (4 points)

100.00	197.00	348.50	197.00	351.50	178.00	450.00	178.00
--------	--------	--------	--------	--------	--------	--------	--------

Failure Surface

Circular surface defined by: XL, XR, R

Intersects: XL: 216.47 YL: 164.00 XR: 385.00 YR: 200.00
Centre: XC: 253.99 YC: 400.85 Radius: R: 239.80

Earthquake Force

Pseudo-static earthquake (seismic) coefficient: 0.042

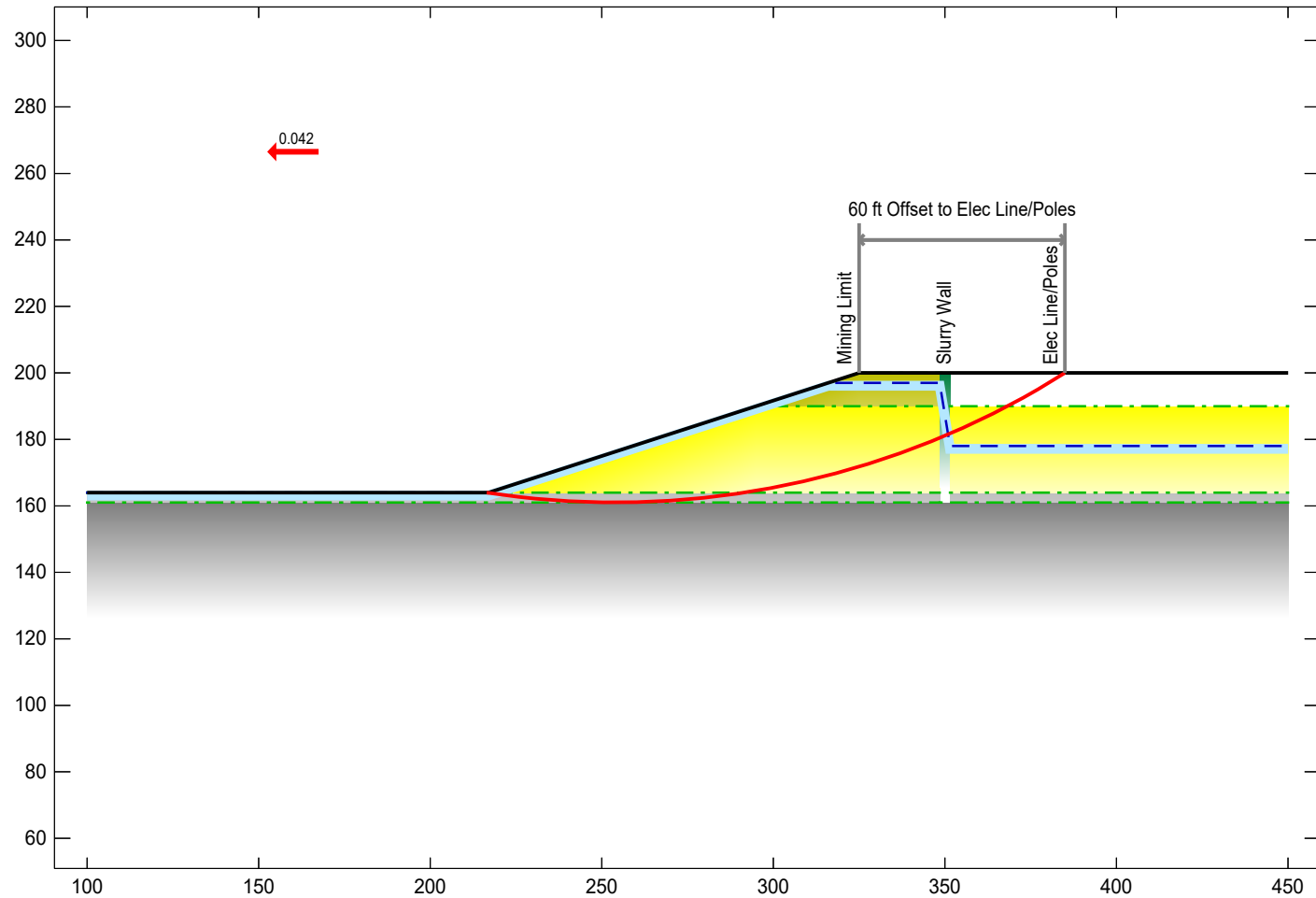
RESULTS: Analysis 1 - Case 5-3 Full Reservoir - Pseudostatic

Bishop Simplified Method of Analysis - Circular Failure Surface

Factor of Safety: 2.20

Slice Geometry and Properties (43 slices)

Slice	X-Left	X-S	Angle	Width	Base Length	Matl	Cohesion	Phi	Weight	PoreWater Force	Normal Stress	Test Factor
1	216.47	4.17	-7.9	4.59	4.64	3	100.00	18.0	560.88	9643.80	2152.30	1.03
2	221.06	14.13	-7.9	4.59	4.64	3	100.00	18.0	1895.30	9828.12	2350.41	1.03
3	225.66	23.81	-5.7	4.62	4.64	3	100.00	18.0	3188.82	9986.78	2532.00	1.02
4	230.27	33.03	-5.7	4.62	4.64	3	100.00	18.0	4417.73	10119.56	2704.33	1.02
5	234.89	41.98	-3.5	4.63	4.64	3	100.00	18.0	5607.08	10226.31	2858.52	1.01
6	239.52	50.42	-3.5	4.63	4.64	3	100.00	18.0	6725.90	10307.35	3005.00	1.01
7	244.15	58.55	-1.2	4.64	4.64	3	100.00	18.0	7799.39	10362.53	3131.92	1.00
8	248.79	66.18	-1.2	4.64	4.64	3	100.00	18.0	8804.25	10391.63	3252.50	1.00
9	253.43	73.41	1.0	4.64	4.64	3	100.00	18.0	9751.17	10394.59	3352.30	1.00
10	258.06	80.21	1.0	4.64	4.64	3	100.00	18.0	10638.90	10371.83	3446.98	1.00
11	262.70	86.47	3.2	4.63	4.64	3	100.00	18.0	11451.28	10323.16	3519.84	0.99
12	267.33	92.43	3.2	4.63	4.64	3	100.00	18.0	12219.30	10248.43	3588.64	0.99
13	271.96	97.67	5.4	4.62	4.64	3	100.00	18.0	12889.86	10147.71	3634.74	0.99
14	276.58	102.76	5.4	4.62	4.64	3	100.00	18.0	13536.31	10021.12	3677.71	0.99
15	281.20	106.95	7.6	4.60	4.64	3	100.00	18.0	14060.69	9868.94	3697.29	0.99
16	285.80	111.17	7.6	4.60	4.64	3	100.00	18.0	14584.72	9690.80	3714.54	0.99
17	290.39	24.64	9.8	1.00	1.01	3	100.00	18.0	3228.48	2088.71	3711.10	0.99
18	291.39	90.52	9.8	3.61	3.66	2	0.00	35.0	11858.17	7469.98	3670.65	0.96
19	295.00	116.72	9.8	4.54	4.60	2	0.00	35.0	15290.32	9185.56	3668.89	0.96
20	299.54	119.62	12.1	4.54	4.64	2	0.00	35.0	15670.50	9002.54	3634.86	0.96
21	304.07	122.09	12.1	4.54	4.64	2	0.00	35.0	15993.22	8722.07	3609.29	0.96
22	308.61	101.02	14.3	3.70	3.81	2	0.00	35.0	13233.75	6944.36	3555.46	0.95
23	312.30	102.10	14.3	3.70	3.81	2	0.00	35.0	13375.07	6720.61	3515.29	0.95
24	316.00	44.48	14.3	1.60	1.65	2	0.00	35.0	5826.62	2836.44	3501.90	0.95
25	317.60	103.49	16.5	3.70	3.86	2	0.00	35.0	13557.49	6458.11	3492.14	0.95
26	321.30	104.00	16.5	3.70	3.86	2	0.00	35.0	13624.28	6194.17	3502.78	0.95
27	325.00	41.74	16.5	1.49	1.56	2	0.00	35.0	5468.51	2425.01	3480.45	0.95
28	326.49	118.55	18.7	4.39	4.64	2	0.00	35.0	15530.59	6942.11	3336.97	0.95
29	330.89	112.02	18.7	4.39	4.64	2	0.00	35.0	14674.43	6511.54	3151.98	0.95
30	335.28	103.66	20.9	4.33	4.64	2	0.00	35.0	13579.04	6056.54	2936.05	0.95
31	339.61	96.48	20.9	4.33	4.64	2	0.00	35.0	12638.69	5577.00	2731.35	0.95
32	343.95	93.21	23.1	4.55	4.95	2	0.00	35.0	12210.69	5398.17	2490.86	0.96
33	348.50	46.28	23.1	2.44	2.65	5	0.00	45.0	5091.17	1365.22	1831.50	0.91
34	350.94	27.85	23.1	1.54	1.67	2	0.00	35.0	3647.80	0.00	2090.17	0.96
35	352.48	70.42	25.4	4.19	4.64	2	0.00	35.0	9225.22	0.00	1912.82	0.96
36	356.67	62.09	25.4	4.19	4.64	2	0.00	35.0	8134.39	0.00	1686.64	0.96



GALENA Version 7.2

Material Keys

- 1: Overburden
- 2: Sand and Gravel
- 3: Weathered Bedrock
- 4: Stable Bedrock
- 5: Slurry Wall

Analysis 1

Single Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

Factor of Safety: 1.36

Edited: 13 Apr 2021 Processed: 13 Apr 2021

Project West Farm Pit Expansion
Case 5-3 Rapid Drawdown - Pseudostatic

File: C:\Users\p...\DRMS West Farm Expansion Case 5-3 Rapid Drawdown-EQ.gmf

Dept of the Interior - Office of Surface Mining

Project: West Farm Pit Expansion
 File: C:\Users\psh\AppData\Local\Temp\2\Temp5_Adequacy Review 1 Res...\DRMS West Farm Expansion Case 5-3 Rapid Drawdown-EQ.gmf
 Processed: 13 Apr 2021 09:08:56

DATA: Analysis 1 - Case 5-3 Rapid Drawdown - Pseudostatic

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden
Cohesion Phi UnitWeight Ru
150.00 22.0 131.00 Auto
Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel
Cohesion Phi UnitWeight Ru
0.00 35.0 131.00 Auto
Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock
Cohesion Phi UnitWeight Ru
100.00 18.0 141.00 Auto
Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock
Cohesion Phi UnitWeight Ru
2000.00 20.0 141.00 Auto
Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall
Cohesion Phi UnitWeight Ru
0.00 45.0 110.00 Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden
100.00 200.00	348.50 200.00
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel
100.00 190.00	348.50 190.00
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock
100.00 164.00	348.50 164.00
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock
100.00 161.00	348.50 161.00
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall
348.50 200.00	351.50 200.00
Profile: 6 (2 points)	Material beneath: 1 - Overburden
351.50 200.00	450.00 200.00
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel
351.50 190.00	450.00 190.00
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock
351.50 164.00	450.00 164.00
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock
348.50 161.00	450.00 161.00

Slope Surface (4 points)

100.00	164.00	217.00	164.00	325.00	200.00	450.00	200.00
--------	--------	--------	--------	--------	--------	--------	--------

Phreatic Surface (6 points)

100.00	164.00	217.00	164.00	316.00	197.00	348.50	197.00	351.50	178.00
450.00	178.00								

Failure Surface

Circular surface defined by: XL, XR, R

Intersects: XL: 216.47 YL: 164.00 XR: 385.00 YR: 200.00
Centre: XC: 253.99 YC: 400.85 Radius: R: 239.80

Earthquake Force

Pseudo-static earthquake (seismic) coefficient: 0.042

RESULTS: Analysis 1 - Case 5-3 Rapid Drawdown - Pseudostatic

Bishop Simplified Method of Analysis - Circular Failure Surface

Factor of Safety: 1.36

Slice Geometry and Properties (43 slices)

Slice	X-Left	X-S Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Porewater Force	Normal Stress	Test Factor
1	216.47	4.17	-7.9	4.59	4.64	3	100.00	18.0	560.88	262.69	134.87	1.04
2	221.06	14.13	-7.9	4.59	4.64	3	100.00	18.0	1895.30	890.32	430.62	1.04
3	225.66	23.81	-5.7	4.62	4.64	3	100.00	18.0	3188.82	1493.22	707.32	1.03
4	230.27	33.03	-5.7	4.62	4.64	3	100.00	18.0	4417.73	2071.34	977.01	1.03
5	234.89	41.98	-3.5	4.63	4.64	3	100.00	18.0	5607.08	2624.22	1225.00	1.02
6	239.52	50.42	-3.5	4.63	4.64	3	100.00	18.0	6725.90	3151.94	1468.52	1.02
7	244.15	58.55	-1.2	4.64	4.64	3	100.00	18.0	7799.39	3654.11	1688.09	1.01
8	248.79	66.18	-1.2	4.64	4.64	3	100.00	18.0	8804.25	4130.65	1905.37	1.01
9	253.43	73.41	1.0	4.64	4.64	3	100.00	18.0	9751.17	4581.15	2096.79	1.00
10	258.06	80.21	1.0	4.64	4.64	3	100.00	18.0	10638.90	5005.81	2287.78	1.00
11	262.70	86.47	3.2	4.63	4.64	3	100.00	18.0	11451.28	5404.24	2451.31	0.99
12	267.33	92.43	3.2	4.63	4.64	3	100.00	18.0	12219.30	5776.34	2616.01	0.99
13	271.96	97.67	5.4	4.62	4.64	3	100.00	18.0	12889.86	6121.85	2751.93	0.98
14	276.58	102.76	5.4	4.62	4.64	3	100.00	18.0	13536.31	6440.81	2890.36	0.98
15	281.20	106.95	7.6	4.60	4.64	3	100.00	18.0	14060.69	6733.14	2998.94	0.98
16	285.80	111.17	7.6	4.60	4.64	3	100.00	18.0	14584.72	6998.57	3111.16	0.98
17	290.39	24.64	9.8	1.00	1.01	3	100.00	18.0	3228.48	1560.39	3159.04	0.97
18	291.39	90.52	9.8	3.61	3.66	2	0.00	35.0	11858.17	5732.83	3145.02	0.93
19	295.00	116.72	9.8	4.54	4.60	2	0.00	35.0	15290.32	7392.10	3226.63	0.93
20	299.54	119.62	12.1	4.54	4.64	2	0.00	35.0	15670.50	7632.82	3275.18	0.92
21	304.07	122.09	12.1	4.54	4.64	2	0.00	35.0	15993.22	7790.01	3342.64	0.92
22	308.61	101.02	14.3	3.70	3.81	2	0.00	35.0	13233.75	6504.53	3363.07	0.91
23	312.30	102.10	14.3	3.70	3.81	2	0.00	35.0	13375.07	6574.00	3398.96	0.91
24	316.00	44.48	14.3	1.60	1.65	2	0.00	35.0	5826.62	2836.44	3422.73	0.91
25	317.60	103.49	16.5	3.70	3.86	2	0.00	35.0	13557.49	6458.11	3399.86	0.90
26	321.30	104.00	16.5	3.70	3.86	2	0.00	35.0	13624.28	6194.17	3406.50	0.90
27	325.00	41.74	16.5	1.49	1.56	2	0.00	35.0	5468.51	2425.01	3382.86	0.90
28	326.49	118.55	18.7	4.39	4.64	2	0.00	35.0	15530.59	6942.11	3232.17	0.90
29	330.89	112.02	18.7	4.39	4.64	2	0.00	35.0	14674.43	6511.54	3052.43	0.90
30	335.28	103.66	20.9	4.33	4.64	2	0.00	35.0	13579.04	6056.54	2833.20	0.89
31	339.61	96.48	20.9	4.33	4.64	2	0.00	35.0	12638.69	5577.00	2634.88	0.89
32	343.95	93.21	23.1	4.55	4.95	2	0.00	35.0	12210.69	5398.17	2393.94	0.89
33	348.50	46.28	23.1	2.44	2.65	5	0.00	45.0	5091.17	1365.22	1710.72	0.83
34	350.94	27.85	23.1	1.54	1.67	2	0.00	35.0	3647.80	0.00	1945.57	0.89
35	352.48	70.42	25.4	4.19	4.64	2	0.00	35.0	9225.22	0.00	1768.91	0.89

36	356.67	62.09	25.4	4.19	4.64	2	0.00	35.0	8134.39	0.00	1559.75	0.89
37	360.86	47.06	27.6	3.66	4.13	2	0.00	35.0	6165.21	0.00	1328.04	0.89
38	364.52	40.07	27.6	3.66	4.13	2	0.00	35.0	5249.78	0.00	1130.84	0.89
39	368.18	8.86	27.6	0.91	1.02	1	150.00	22.0	1160.09	0.00	1057.20	0.98
40	369.08	33.71	29.8	4.03	4.64	1	150.00	22.0	4415.97	0.00	883.44	0.98
41	373.11	24.43	29.8	4.03	4.64	1	150.00	22.0	3200.63	0.00	625.44	0.98
42	377.13	14.50	32.0	3.93	4.64	1	150.00	22.0	1900.14	0.00	349.21	0.99
43	381.07	4.83	32.0	3.93	4.64	1	150.00	22.0	633.38	0.00	77.62	0.99
		-----			-----							
	X-S Area:	2917.79	Path Length:	176.26			X-S Weight:	382715.25				
